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(54) Title: INK JET RECORDING SHEET		
(57) Abstract <p>Curable, UV or visible light-photopolymerizable compositions of the invention suitable for use as ink-receptive coatings include a curable matrix containing at least one reactive monomer, and at least one ink-receptive polymer capable of dissolving therein, and from 0.1 part to 10 parts photoinitiator per 100 parts curable matrix, such matrix being ink-receptive when cured.</p>		

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INK-JET RECORDING SHEETBackground of the InventionField of the Invention

The present invention relates to compositions suitable for use as imageable
5 coatings for ink-jet recording sheets, to the recording sheets coated with such
compositions, and to a nonsolvent type process for making such sheets.

Description of the Art

Imaging devices such as ink-jet printers and pen plotters are established
methods for printing information including labels and multi-color graphics.
10 Presentation of such information has created a demand, not only for improved papers
for use therewith, but also for transparent, ink receptive, imageable sheets that are
used as overlays in technical drawings and as transparencies for overhead projection.
Imaging with either the ink-jet printer or the pen plotter involves depositing ink on the
surface of these transparent receptors. These imaging devices conventionally utilize
15 inks that can remain exposed to air for long periods of time without completely
drying. Since it is desirable that the surface of these receptors to appear dry and non-
tacky to the touch soon after imaging, even after deposition of significant amounts of
liquid, it is desirable that transparent materials for imaging be capable of absorbing
significant amounts of liquid while maintaining some degree of durability and
20 transparency.

U.S. Patent No. 4,379,804, an early patent for a film suitable for imaging in an
ink-jet printer, claimed a two-layer coating where one layer retained dye and a second
layer retained associated solvent. This gave a precise image with a surface that dried
more quickly than the single layer coatings of the time.

25 Another approach to the problem of drying is disclosed in U.S. Patent No.
5,104,730, which teaches a transparent film having on its surface a layer of "pseudo-
boehmite", thereby creating a porous structure to absorb the ink.

A more complex type of ink-receptive coating for use with ink-jet printers is
the semi-interpenetrating polymer network (SIPN). These networks typically
30 comprise a hydrophobic or hydrophilic matrix polymer that anchors a water-soluble
polymer in place. These networks have good ink receptivity and durability.

However, either polymer alone is not useful. Without the matrix polymer, the imaged water-soluble polymer rapidly loses durability, especially in high humidity environments. Conversely the matrix polymer alone has limited ink-receptivity and cannot be sufficiently imaged. Such SIPNs have typically required solvents for the coating process, which are then dried off to provide the final product. Such a process involves significant expense both in purchase of solvents, and in process equipment to prevent environmental impact from such solvent after removal from the coating. SIPN type ink-receptive coatings are disclosed in e.g., U.S. Patent Nos. 5,389,726; 5,472,789; 5,241,006; 5,376,727 and 5,308,092.

Alternative methods for preparation of SIPN compositions include the polymerization of suitable monomers around a previously prepared polymer as disclosed in U.S. Patent No. 3,928,113 and 3,041,292 by means of a crosslinking agent.

However, as the need for inkjet films has increased, so has the need to develop economic and environmentally friendly means for their production. In recent years, the solvent of choice for preparation of coatings of organic materials has been water, replacing large quantities of volatile organic compounds. However, there are practical limits to the amount of water that a coating machine can remove from a thin coating in a set period of time, which affects the throughput of the plant, and thus the economy thereof. One type of process which uses no solvent and thus has no emissions, nor any drying load is known as 100% solids coating. In essence, a liquid can be coated by any of the processes known in the art, and then rendered solid by one of several methods, i.e., the use of a reactive diluent which initiates a reaction when a catalyst is added or when the coating is heated, the use of photoinitiation to cause a reaction, and the like. For a general discussion of such techniques, see "*Contemporary Industrial Coatings*", Ernest Flick, Noyes Publishing Company, (1985).

Photopolymerization by means of ultraviolet (UV) irradiation is known for pressure-sensitive adhesives and the like. See, e.g., U.S. Patents 4,181,752; 5,024,880; 4,895,738; 5,085,088 and EPO Patent 352901.

U.S. Patent No. 4,364,972 discloses a UV polymerized pressure-sensitive adhesive which comprises an acrylic acid ester of a nontertiary alcohol and N-vinyl-2-pyrrolidone which adheres strongly to plastic and to automotive paints. The adhesive

has a thickness of from 25 to 250 μm and is formed by a two step prepolymerization and polymerization process.

In fact, most such processes involve prepolymerization of monomers to a high viscosity syrup prior to coating, and subsequent completion of the polymerization.

- 5 This process is unsuitable for coating thin layers, i.e., less than 50 μm . Further, such processes are also typically carried out in an inert atmosphere, which is very troublesome and expensive to maintain.

- Further, the majority of coatings made by this means previously are unreactive and especially nonabsorptive of water, rendering ink absorbing aqueous coatings
10 difficult to create. To date, attempts to photopolymerize image recording sheets have required use of organic solvents, either totally or partially, rather than being 100% solids processes. See, e.g., U.S. Patent No. 5,476,752 which discloses a radiation imageable coating that comprises a linear poly(methylmethacrylate) solution coated from methylethylketone and toluene, dried and then irradiated. Uncrosslinked
15 material may then be removed by washing, and U.S. Patent 4,960,638 which discloses a recording sheet formed by radiation curing of a hydrophilic resin prepolymer having a polyoxyethylene structure with reactable endgroups. These coatings can be prepared from 50% aqueous solutions, still requiring extensive drying.

- The instant inventors have now discovered a process for forming an ink-jet
20 recording sheet having an ink-receptive coating using a 100% solids coating process. The process needs neither vaporizable solvents nor a drying step. The process is carried out in an integrated manner, and does not require inerting of the atmosphere. The formulation is formed from monomers which provide the necessary solvation of the water-soluble polymer, and which are reactive in ultraviolet light to the extent that
25 the matrix polymer is synthesized upon irradiation with ultraviolet radiation yielding a coatable composition for use in ink-receptive sheets.

Summary of the Invention

- The present invention provides a composition suitable for use on a substrate as an ink-jet recording sheet, an ink-jet recording sheet having said composition coated
30 onto at least one major surface, and a process for making said recording sheet.

Coatable, UV-photopolymerizable, compositions of the invention suitable for use as ink-receptive coatings comprise a curable matrix comprising:

- a) at least one reactive monomer, and
- b) at least one ink-receptive polymer capable of dissolving therein,

said composition also comprising from 0.1 part to 10 parts photoinitiator per 100 parts of said curable matrix, said matrix being ink-receptive when cured.

5 Preferred curable matrices of the invention comprise:

- a) a reactive monomer mixture, and
- b) at least one ink-receptive polymer capable of dissolving therein,

said composition also comprising from 0.1 part to 10 parts photoinitiator per 100 parts of said curable matrix, said matrix being ink-receptive when cured.

10 Especially preferred monomer mixtures includes mixtures of at least one (meth)acrylate and acrylic acid.

An ink-jet recording sheet of the invention comprises a polymeric substrate having coated thereon at least one cured layer of a coatable composition of the invention.

15 Ink-jet recording sheets may be made by a process of the invention having the steps of:

- a) providing a substrate having two major surfaces,
- b) coating a UV-photopolymerizable composition comprising at least one reactive monomer, at least one ink-receptive polymer capable of dissolving
- 20 therein, and at least one photoinitiator on at least one major surface thereof,
- c) exposing such coating to ultraviolet radiation.

The coating must be exposed to a sufficient amount of radiation to render the surface nontacky. Preferred coatings of the invention are exposed to radiation for at least about 1 minute, however, this is dependent on such factors as the amount of

25 photoinitiator, the wavelength and the intensity of the radiation.

The following terms have the defined meanings when used herein.

1. The term "ultraviolet radiation" refers to radiation having an average wavelength of from 250 nm to 400 nm.
2. The term "crosslinkable" means capable of forming covalent or strong
- 30 ionic bonds with itself or with a separate agent added for this purpose.
3. The term "hydrophilic" is used to describe a material that is generally receptive to water, either in the sense that its surface is wettable by water or in the

sense that the bulk of the material is able to absorb significant quantities of water.

Materials that exhibit surface wettability by water have hydrophilic surfaces.

Monomeric units will be referred to as hydrophilic units if they have a water-sorption capacity of at least one mole of water per mole of monomeric unit.

5 4. The term "hydrophobic" refers to materials which have surfaces not readily wettable by water. Monomeric units will be referred to as hydrophobic if they form water-insoluble polymers capable of absorbing only small amounts of water when polymerized by themselves.

10 5. The term "surfactant" means a compound which reduces surface tension, thereby increasing surface wetting.

6. The term "mordant" means a compound which, when present in a composition, interacts with a dye to prevent diffusion of a dye through the composition.

15 7. The term "curable matrix" means the total reactive ingredients, exclusive of additional ingredients such as photoinitiator and adjuvants.

8. The term "(meth)acrylate" includes both acrylate and methacrylate variations of the compound.

20 9. The term "mudcracking" is used in the industry, and refers to an image defect that appear under a microscope as a series of cracks in a solid image. This has an appearance similar to that seen when wet mud dries. It is thought to be caused by low cohesion of imaging layers.

All ratios, parts, and percents described herein are by weight, unless otherwise specifically stated.

Detailed Description of the Invention

25 Reactive monomers useful in ink-receptive formulations of the invention are those monomers which provide not only a reactant for the photopolymerization, but also act as a solvent for dissolution of at least one water soluble polymer. When subjected to irradiation by ultraviolet light, a matrix polymer is formed from the reactants directly without need for additional solvents or diluents.

30 Classes of reactive monomers include acrylics, olefins, silicones, urethanes, esters, and amides. Preferred classes include acrylics and tackified acrylics and urethanes. Especially preferred reactive monomers include such acrylate monomers

as methyl (meth)acrylate, ethyl (meth)acrylate, 1-hydroxyethyl (meth)acrylate, dimethylaminomethacrylate, dimethylaminoethylacrylate, and the like.

Reactive monomers comprise from 10 to 50 percent by weight of the reactive, preferably from 40 to 60 percent by weight.

5 Preferred curable matrices of the invention comprise reactive monomer mixtures; useful mixtures include at least one (meth)acrylate, e.g., methyl methacrylate, ethyl acrylate, ethyl methacrylate and the like, and a polar monomer such as acrylic acid. In one embodiment, the monomer mixture comprises from 25% to 40% of the (meth)acrylate and 1% to 15% of acrylic acid.

10 Correspondingly, coatable formulations of the invention contain from 50 percent by weight to 90 percent by weight of the soluble polymer per 100 parts reactants. Useful polymers include those polymers which are not only soluble in the reactive monomer at such loadings, but are water-soluble as well.

Examples of useful polymers include polyvinylpyrrolidone, vinylpyrrolidone
15 copolymers, poly (2-ethyl-2-oxazoline), and the like.

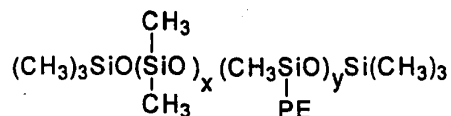
A particularly preferred water soluble polymer is a PVP/VA water-soluble copolymer, such copolymer having a vinyl acetate content of 40% or less. Two such copolymers commercially available are PVP/VA S-630, which has a 60/40 ratio and a
20 molecular weight of 30,000 to 50,000, and PVP/VA S-735, with a PVP/VA ratio of 70/30, and a molecular weight of 30,000 to 50,000.

The composition must contain a photoinitiator. Photoinitiators useful in formulations of the invention include acyloin ethers and substituted acyloin ethers such as benzoin ether, anisoin ethyl ether; and alphahydroxymethyl benzoin ether; benzophenones, such as 4,4'-bis(dimethylamino)benzophenone; tertiary amines;
25 substituted acetophenones such as benzyl 2,2-diethoxyacetophenone, benzyl dimethylketal, anthroquinones, 1-hydroxycyclohexyl phenyl ketone, available from Ciba Geigy as Irgacure® 184, 2-hydroxy-2-methyl-1-phenylpropan-1-one, available from Ciba Geigy as Darocur® 1173, and certain chromophore-substituted vinylhalomethyl-s-triazines, such as 2,4-bis(trichloromethyl)-6-p-methoxy-s-triazines;
30 photoactive oximes, and mixtures thereof. The photoinitiator or mixture of photoinitiators should be present in an amount of from 0.1 parts to 10 parts per 100 parts of curable components (polymer and monomer added) preferably from 0.5 parts

to 5 parts of the curable components. A blend of photoinitiators may be desired when bulk properties different from surface properties are desired, or other property gradients. For example, this enables the surface to be more highly cured and tough, while allowing the interior portion of the SIPN to remain less cured and more ink-receptive.

The composition preferably includes a crosslinking agent. Useful crosslinking agents include multifunctional acrylates such as 1,6-hexandiol diacrylate, 1,8-octanediol diacrylate, and the like; methenebisacrylate; divinylbenzene; acetaldehyde; anthroquinone and substituted anthroquinones, and various benzophenone type compounds. Multifunctional acrylates are preferred crosslinking agents. When present, the crosslinking agent preferably comprises from 1 part to 10 parts of the composition.

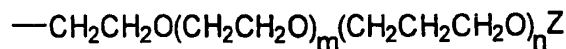
The composition may also include a surfactant in small amounts in order to minimize mudcracking and improve the density of the image. Useful surfactants include anionic surfactants, nonionic surfactants, fluorochemical surfactants, available from Texaco as Jeffamine®, and silicone surfactants, particularly a silicone surfactant having the formulas:



or the formula



wherein PE represents the formula



m being an integer of from 1 to 40, n having a value of from 0 to 40-m, and Z is hydrogen or an alkyl radical having from 1 to 10 carbon atoms. A commercial example of such silicones is the Silwet 7600® series, available from Union Carbide.

The formulation may also include particulates, such as polymeric microspheres or beads, which may be hollow or solid, for the purpose of improving handling and flexibility in amounts that do not unduly interfere with UV initiation. Preferred particulate materials are formed from polymeric materials such as

~~poly(methylmethacrylate), poly(stearyl methacrylate) hexanedioldiacrylate~~

copolymers, polyethylene, starch and silica. Poly(methylmethacrylate) beads are most preferred. Levels of particulate are limited by the requirement that the final coating be transparent with a haze level of 15% or less, as measured according to ASTM D1003-61 (Reapproved 1979). The preferred mean particle diameter for particulate material is from 5 to 40 micrometers, with at least 25% of the particles having a diameter of 15 micrometers or more. Most preferably, at least 50% of the particulate material has a diameter of from 20 micrometers to 40 micrometers.

Additional additives can also be incorporated in small amounts to improve processing, including thickeners such as xanthan gum, catalysts, thickeners, adhesion promoters, glycols, defoamers, antistatic materials, and the like. An additive which may be present to control curl is a plasticizing compound. Useful compounds include, e.g., low molecular weight polyethylene glycols, polypropylene glycols, or polyethers; for example PEG 600, Pycal® 94, and Carbowax® 600.

Fillers such as pigments etc. are useful where reflective coatings are desired, however, caution must be used to add only those types and amounts which do not unduly inhibit the photopolymerization.

Film substrates may be formed from any polymer capable of forming a self-supporting sheet, e.g., films of cellulose esters such as cellulose triacetate or diacetate, polystyrene, polyamides, vinyl chloride polymers and copolymers, polyolefin and polyallomer polymers and copolymers, polysulphones, polycarbonates and polyesters. Suitable polyester films may be produced from polyesters obtained by condensing one or more dicarboxylic acids or their lower alkyl diesters in which the alkyl group contains up to 6 carbon atoms, e.g., terephthalic acid, isophthalic, phthalic, 2,5-, 2,6-, and 2,7-naphthalene dicarboxylic acid, succinic acid, sebacic acid, adipic acid, azelaic acid, with one or more glycols such as ethylene glycol, 1,3-propanediol, 1,4-butanediol, and the like.

Preferred film substrates are cellulose triacetate or cellulose diacetate, polyesters, especially poly(ethylene terephthalate), and polystyrene films.

Poly(ethylene terephthalate) is most preferred. It is preferred that film substrates have a caliper ranging from 50 micrometers to 125 micrometers. Film substrates having a caliper of less than 50 micrometers are difficult to handle using conventional methods

~~for graphic materials. Film substrates having calipers over 125 micrometers are very~~
stiff, and present feeding difficulties in certain commercially available ink-jet printers and pen plotters.

When polyester or polystyrene film substrates are used, they are preferably
5 biaxially oriented, and may also be heat set for dimensional stability during fusion of the image to the support. These films may be produced by any conventional method in which the film is biaxially stretched to impart molecular orientation and is dimensionally stabilized by heat setting.

Ink-jet recording sheets of the invention are particularly useful in the
10 production of images for viewing in a transmission mode, e.g., in association with an overhead projector, and are often called "transparencies".

In the method of processing, the composition is coated onto the substrate, and irradiated. Useful coatings, i.e., those which are image receptive and radiation polymerizable have thicknesses of from 3 micrometers to 25 micrometers, preferably
15 from 7 μm to 14 μm .

UV-photopolymerizable compositions of the invention are coatable although fairly high in viscosity. The compositions are coated onto the substrate by conventional means such as Meyer bar coating, knife coating, reverse roll coating, rotogravure coating, extrusion coating, and the like. After coating, the composition is
20 then exposed to ultraviolet radiation.

While a single ultraviolet light may be used for photopolymerization of small samples, production purposes requires the radiation to be supplied by a multiplicity of ultraviolet lamps, such as low, medium or high pressure mercury vapor lamps. The intensity of the irradiation should preferably be from about 300 milliwatts/cm² to
25 about 700 milliwatts/cm². The lamps used for the irradiation should provide emissions such that at least 75% of said emissions are between from 250 nm and 500 nm, preferably at least 90% being in such range and having a maximum at either 254 or 365 nm.

Lamp exposure times typically range from 2 minutes to 10 minutes, preferably
30 from 4 minutes to 7 minutes for those thicknesses of coating described; however, the time of irradiation is also dependent upon such factors as type and amount of photoinitiator and may vary.

The following examples are for illustrative purposes only, and are not meant to be limiting. One skilled in the art will easily think of variations within the scope of the invention, which is solely that defined by the claims.

Test Methods

Image Density

5

The transmissive image density is measured by imaging the color desired, and measuring using a Macbeth TD 903 densitometer with the gold and status A filters. Black image density is evaluated by measuring the density of a solid fill black rectangle image.

Examples

10

Example 1

Preparation of the Material

A coating solution was made up by mixing:

	<u>Ingredient</u>	<u>Parts (by weight)</u>
15	Ebercryn® 4833	33 parts
	N-vinyl pyrrolidone (NVP)	33 parts
	PVP/VA S-630	30 parts
	Irgacure® 651	4 parts

Ebercryn® 4833 is an aliphatic urethane diacrylate diketal containing 10% NVP and supplied by UCB Radcure®. "PVP/VA S630" is supplied by ISP, Inc., and is a water soluble resin that is a copolymer of N-vinyl pyrrolidone and vinyl acetate having a monomer ratio of 60/40. The solution was coated onto 100 mm poly(ethylene terephthalate) to a weight of 9 g/square meter, and exposed to ultraviolet radiation emitted by a low pressure mercury lamp, having a lamp intensity of 66 mW/cm² at 1 meter (at 254 nm) for two minutes. A material capable of performing as an ink jet receptor sheet resulted. The coating was tackfree, and dried rapidly to the touch. When imaged, the image exhibited bright clear colors when projected. The results are shown in Table 1.

25

Example 2

	<u>Ingredient</u>	<u>Parts (by weight)</u>
	Ethyl acrylate	48.8 parts
	Irgacure 651	2.4 parts
5	PVP/VA S-630	48.8 parts

This sample was coated, and irradiated as above, except that it was exposed to the lamp for 2.5 minutes. The results are shown in Table 1.

Example 3

10	<u>Ingredient</u>	<u>Parts (by weight)</u>
	Methyl methacrylate	48.8 parts
	Irgacure 651	2.4 parts
	PVP/VA S-630	48.8 parts

15 This sample was coated, and irradiated as above, except that it was exposed to the lamp for 2.5 minutes. The results are shown in Table 1.

Example 4

These were coated as above for 2.5 minutes. The results are shown in Table 1.

	<u>Ingredient</u>	<u>Parts (by weight)</u>
20	2-hydroxyethyl acrylate	48.8 parts by weight
	PVP/VA S-630	48.8 parts
	Irgacure 651	2.4 parts

This sample were coated and irradiated as above, except that it were exposed to the lamp for 2.5 minutes. The coating was tackfree, and dried rapidly to the touch.

25 When imaged, the image exhibited bright clear colors when projected.

It was also noted that a coating containing di-, tri-, and tetra-acrylate crosslinkers, plus acrylic acid, gave results that were superior to the results produced by the acrylates or the acid alone.

Example 5

These were coated as above for 2.5 minutes. The results are shown in Table 1.

	<u>Ingredient</u>	<u>Parts (by weight)</u>
	Ethyl acrylate	100 parts
5	Acrylic acid	10 parts
	1,6-hexanedioldiacrylate	2.5 parts
	Irgacure 651	5 parts
	PVP/PA S-630	125 parts

Example 6

10 The ingredients and conditions are identical to those of Example 5, except that 10 parts of Irgacure® 651 was used; rather than 5 parts to measure the effect, if any, of additional photoinitiator.

15 This increase in photoinitiator caused an increased hardening of the surface of the coating, while the portion of the coating adjacent to the film substrate had the same or less hardening than examples using 5 parts of the photoinitiator. This phenomenon is thought to result in a reduction of surface swell when ink is applied, and less contraction upon drying. The surface of the dye or pigment is therefore subjected to less lateral force and is less likely to exhibit mudcracking. Less mudcracking is reflected generally in higher observed black density readings, as can
20 be seen in Table 1.

The results are shown in Table 1.

Table 1

Example	Printer	Red	Green	Blue	Black	Dry time relative to control*
1 Control (3410)	Epson Stylus	0.80	0.77	0.72	0.71	0
	Epson Stylus	0.77	0.72	0.66	0.64	0
2 Control (3410)	Epson Stylus	0.91	0.83	0.80	0.84	0
	Epson Stylus	0.78	0.71	0.68	0.65	0
3 Control (3410)	Canon BJC610	1.51	1.70	1.67	2.47	-
	Canon BJC610	1.33	1.50	1.56	2.35	0
4 Control (3410)	Canon BJC610	1.50	1.56	1.65	2.55	0
	Canon BJC610	1.31	1.53	1.58	2.35	0
5 Control (3460)	HP 850C	1.2	1.73	1.98	0.99	+
	HP 850C	1.11	1.62	1.80	1.46	0
6 Control (3460)	HP 850C	1.05	1.41	1.40	1.90	+
	HP 850C	1.04	1.52	1.66	1.80	0

* "+" designates performance better than the control
 "0" designates performance equivalent to the control
 "-" designates performance worse than the control

What is Claimed is:

1. A coatable, photopolymerizable composition suitable for use as an ink-receptive coating, comprising a curable matrix comprising:
 - a) at least one reactive monomer, and
 - 5 b) at least one ink-receptive polymer capable of dissolving therein,said composition also comprising from 0.1 part to 10 parts photoinitiator per 100 parts of said curable matrix, said matrix being ink-receptive when cured, said composition being photopolymerizable by light selected from visible light and ultraviolet light.
- 10 2. A coatable, photopolymerizable composition according to claim 1 wherein said reactive monomer comprises at least one (meth)acrylate.
3. A coatable, photopolymerizable composition according to claim 2 comprising a mixture of reactive monomers.
4. A coatable, photopolymerizable composition according to claim 3
15 wherein said mixture includes a polar monomer.
5. A coatable, photopolymerizable composition according to claim 12 wherein said polar monomer is acrylic acid.
6. A coatable, photopolymerizable composition according to claim 5 comprising from 25% to 40% (meth)acrylate and from 1% to 15% acrylic acid.
- 20 7. A coatable, photopolymerizable composition according to claim 1 wherein said ink-receptive polymer is selected from the group consisting of polyvinylpyrrolidone, vinylpyrrolidone copolymers, poly(2-ethyl-2-oxazoline), and copolymers of polyvinylpyrrolidone and vinyl acetate.
8. A coatable, photopolymerizable composition according to claim 1
25 wherein said reactive mixture comprises from 10% to 50% of said reactive monomer, and correspondingly, from 50% to 90% of said ink-receptive polymer.

9. A process for making an ink-jet recording sheet having at least one

major surface coated with the composition of claim 1 having the steps:

- a) providing a substrate having two major surfaces,
- b) coating a UV-photopolymerizable composition comprising at least one
5 reactive monomer, at least one ink-receptive polymer capable of dissolving
therein, and at least one photoinitiator on at least one major surface thereof,
- c) exposing such coating to ultraviolet radiation for a time sufficient to
render the surface nontacky, said time being at least 1 minute.

10. A process for making an ink-jet recording sheet having at least one major

10 surface coated with the composition of claim 1 having the steps:

- a) providing a substrate having two major surfaces,
- b) coating a visible light-photopolymerizable composition comprising at
least one reactive monomer, at least one ink-receptive polymer capable of
dissolving therein, and at least one photoinitiator on at least one major surface
15 thereof,
- c) exposing such coating to ultraviolet radiation for a time sufficient to
render the surface nontacky.

INTERNATIONAL SEARCH REPORT

International Application No.

US 98/09331

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B41M5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B41M G03F C09D C08F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 121 421 A (POLSKA AKADEMIA NAUK ZAKLAD) 21 December 1983 see examples see claim 1	1-5,7
X	EP 0 740 214 A (NIPPON ZEON CO) 30 October 1996 see page 7, line 55 - page 8, line 25 see claim 1	1-5,8
X	EP 0 666 504 A (DU PONT) 9 August 1995 see example 1 see claim 1	1-3
A	WO 92 07722 A (MINNESOTA MINING & MFG) 14 May 1992 see the whole document	1-10

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern 1st Application No
T/US 98/09331

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